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Reply to the Office action dated March 22, 2005

REMARKS

Examiner Lindsay is thanked for the thorough Office Action.

In the claims

Claims 13 to 39 are Canceled.

New dependent claim 40 is added. New claim 40 has some of the limitations of allowable claim 6.

No new matter is added.

Election/Restriction (with traverse)

The instant office action in paragraph 1 and 2 states that applicant elected claims 1-12 **without traverse** the restriction requirement. However, applicant **did traverse the restriction requirement in the previous response**. See applicant's response to office action dated Jan. 4, 2005, page 12, first paragraph which is shown below:

Provisional Election

Applicant provisionally elects to be examined the Invention described by the Examiner as Group VI. - Claims 1-10 (and amended method claims 11 and 12 that depend from claim 1). **This election is made with traverse** of the requirement under 37 C.F.R. 1.143 for the reasons given in the following paragraphs.

See applicant's response to office action dated Jan. 4, 2005, page 12, first paragraph (emphasis added). Furthermore, applicant's response to office action dated Jan. 4, 2005, pages 12 and 13 gives cogent reasons why the traverse of the restriction requirement is valid.

Applicant respectfully requests that provisional election with traverse be entered.

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Rejection of Claims 1-4, 7-8 and 10-11 under 35 U.S.C. 103(a) as being unpatentable over Buynoski (U.S. Patent No. 5,729,045 dated 5/17/1998) in view of Whiston et al. (U.S. Patent No. 6,835,627 filed 1/10/2000)

Applicant acknowledges the rejection of Claims 1-4, 7-8 and 10-11 under 35 U.S.C. 103(a) as being unpatentable over Buynoski (U.S. Patent No. 5,729,045 dated 5/17/1998) in view of Whiston et al. (U.S. Patent No. 6,835,627 filed 1/10/2000). Reconsideration and withdrawal of the rejection is respectfully requested in view of the comments.

The combination of the Buynoski (U.S. Patent No. 5,729,045 dated 5/17/1998) and Whiston et al. (U.S. Patent No. 6,835,627 filed 1/10/2000) is improper

The combination of the Buynoski and Whiston et al. is improper. First, neither patent suggests their combination. The patents do not solve same problems and therefore no motivation to combine them. The combination of references could only be made in hindsight. Also explained below, the references teach against each other concerning the implant process.

Even if combined, the reference do not meet or suggest applicant's claim 1

Applicants claim 1 states:

1. (ORIGINAL) A method of fabrication of doped regions in a semiconductor device; comprising the steps of:
 - a) providing a {001} silicon substrate;
 - b) forming a gate over said silicon substrate; said gate having a width and a length; a channel under the gate; said channel having a channel direction parallel with the direction of said gate width; said channel direction is [100] or [010] direction;
 - c) implanting ions into said silicon substrate to form a doped region adjacent to said gate; the implantation of ions comprises a large angle tilt implant with a twist of between about 40 and 50 degrees and a tilt angle of 40 and 50 degrees.

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The instant office action, para. 6, states:

Buynoski shows the method substantially as claimed, in Figs. 1-5 and corresponding text, as: providing a {001} silicon substrate (20) (col. 3, line 60- col. 4, line 6); forming a gate (G) over said silicon substrate; said gate having a width and a length; a channel under the gate; said channel having a channel direction parallel with the direction of said gate width; said channel direction is [100] or [010] direction (col. 4, line 7-22); and a twist of between about 40 and 50 degrees (col. 4, lines 7-22) (claim 1).

Claim 1, step B is not suggested by Buynoski

Claim 1 step b claims "said channel direction is [100] or [010] direction;" In contrast, Buynoski channel is in [110] crystal direction. See Buynoski, col. 5, line 65 to col. 6, Line 6.

In accordance with the present invention, the channel is aligned approximately parallel with the [110] crystal direction as shown by the double headed arrow 67 so as to take advantage of the higher drift velocity or mobility in [110] crystal direction for the majority carriers in the channel, whether they are electrons or holes.

Therefore Buynoski teaches against applicant's claim 1, step b. Therefore, no reference suggests applicant's claim 1, step b.

Applicant's claim 1 step C is not suggested by Buynoski

Applicant's claim 1 step C states:

c) implanting ions into said silicon substrate to form a doped region adjacent to said gate; the implantation of ions comprises a large angle tilt implant with a twist of between about 40 and 50 degrees and a tilt angle of 40 and 50 degrees.

The instant office action, para. 6, states:

Additionally Buynoski shows that: the substrate is twisted between 40 and 50 degrees (col. 4, lines 7-22).

However, this citation is not related to an implant process such as applicant's. Also, the citation does not mean anything without a reference to the crystal orientation and the

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channel direction. As stated above, Buynoski's orientation is different than applicant's claim 1, therefore any "twist" is also different.

Furthermore, the Buynoski (col. 4, lines 7-22) cited in The instant office action, para. 6, states:

For the purposes of a more detailed explanation, FIG. 3 shows two superimposed portions 23 and 24 of a {100} silicon wafer. As a point of reference for comparing the crystal directions of the two portions, -x and +x axes and -y and +y axes dissect the two portions, with the +z axis being shown at the center of the two portions. The -z axis is under FIG. 3 and not shown. As can be seen from this Figure, negative and positive <100> crystal directions are parallel with the -x and +x axes respectively, and negative and positive [010] crystal directions are parallel with the -y and +y axes, respectively. In contrast, portion 24, which is illustrative of the present invention, is offset from portion 23 by 45.degree.. Its crystal directions are all [110] and are offset from either the x and y axes by 45.degree., the specific [110] direction depending upon the particular negative integer or integers as shown in FIG. 3.

See Buynoski (col. 4, lines 7-22).

Applicant's Claim 1 step C is not suggested by Buynoski. Buynoski (col. 4, lines 7-22) does not discuss any implant process in contrast to claim 1's claimed implant process. Furthermore, Buynoski (col. 4, lines 7-22) does not suggest applicant's claim 1, step c, twist and tilt implant process.

The combination of Buynoski and Whiston do not meet or suggest the limitations in applicant's claim 1.

The instant office action (page 4) posits:

Whiston shows the forming of an LDNMOS device. Whiston shows the formation an LDMOS device by implanting ions at a 45° tilt angle (col. 5, line 53-col. 6, line 16)The angled implant helps to achieve a desirably low drain/source threshold voltage (the dose and energy level of the dopant required are such as to result in a relatively low punchthrough breakdown voltage (col. 1, line 62- col. 2, line 15).

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the method Buynoski by adjusting the tilt angle between 40 and 50 degrees in a LDMOS device, as taught by Whiston, with the motivation that Whiston teaches that to achieve a desirably low drain/ source

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threshold voltage the dose and energy level of the dopant required are such as to result in a relatively low punchthrough breakdown voltage.

Applicant respectfully argues that the combination of Buynoski and Whiston is improper as discussed above. There is no reason for modifying Buynoski's FET with LLD Source/Drain regions 59 and 60 and Source and drain regions 51 52 (See fig 5, col. 41 to 54) with a Whiston's (no twist) tilt implant process. Buynoski's uses spacers 58 on gate 53 to form the LLD's 59 and 60 to "achieve a desirably low drain/ source threshold voltage the dose and energy level of the dopant required are such as to result in a relatively low punchthrough breakdown voltage." There is no need to perform a tilt implant to change the LLD dopant profiles.

Furthermore, combination of Buynoski and Whiston do not meet or suggest the limitations in applicant's claim 1.

Whiston (and Buynoski) does not suggest using a applicant's claim 1 step b channel orientation.

Whiston (and Buynoski) does not suggest using applicant's claim 1 step (C) twist and tilt implant. In contrast, Whiston teaches against claim 1(c) by teaching a "tilt" only implant.

Claims 2, 3, 4, 7, 8 9, 10, and 11 are non-obvious over the combination of references

Claims 2, 3, 4, 7, 8 9, 10, and 11 and 40 are non-obvious over the combination of references. The above claims depend from non-obvious parent claim 1.

The instant office action states:

Buynoski lacks anticipation only on not explicitly teaching that: 1) implanting ions into said silicon substrate to form a doped region adjacent to said gate; the implantation of ions comprises a large angle tilt implant with a twist of between about 40 and 50 degrees and a tilt angle of 40 and 50 degrees (claim 1); 2) the doped region is a N-LDD in an offset LDMOS FET (claim 2); 3) said ions being implanted about a long the [110] directions of the silicon substrate (claim 3); 4) the implanting of said ions is performed in one implant step at an about 45 degree twist implant and a tilt angle of about 45 degrees (claim 4); 5) said channel has an annular shape with a doped region on the inside of said channel and a second doped region surrounding the outside of said channel (claim 7) 6) said channel has an annular

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shape with a doped region on the inside of said channel region and a second doped region surrounding the outside of said channel; and the implanting of said ions further comprises a quadrupole implant at the twist angles of about 45, 135, 225 and 315 degrees with a range of +/- 5 degrees; and a tilt angle between 40 and 50 degrees (claim 8); 7) further includes forming a High Vt NMOS FET from said gate and doped regions (claim 10); and 8) a LDMOS device is formed (claim 11).

The instant office action has not stated where in the Buynoski or Whistler the applicant's claims are shown or suggested. Therefore these claims are non-obvious.

new claim 40 is non-obvious

New claim 40 is non-obvious over the cited references. New claim 40 depends from non-obvious parent claim 1. Claim 40 has some of the limitations of allowable claim 6. Furthermore, neither reference suggests the claim 40 limitation:

"the implantation comprises an implant with a 45 tilt and 45 twist and the ions enter the substrate aligned at a $\langle 0 - 1 - 1 \rangle$ direction whereby the direction increases the channeling."

ALLOWABLE SUBJECT MATTER

Applicant acknowledges that Claims 5-6 and 12 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicant respectfully requests that the rewriting of claims be held in abeyance till final determination of the other claims.

Pending Claims

It is believed that all the pending claims have been addressed. However, the absence of a reply to a specific rejection, issue or comment does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above may not be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this

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paper, and the amendment of any claim does not necessarily signify concession of the unpatentability of the claim prior to its amendment.

CONCLUSION

In conclusion, reconsideration and withdrawal of the restriction requirement is respectfully requested. Allowance of all claims is requested. Issuance of the application is requested.

It is requested that the Examiner telephone the undersigned attorney at (215) 670-2455 should there be anyway that we could help to place this Application in condition for Allowance.

Charge to Deposit Account

The Commissioner is hereby authorized to apply any fees or credits in this case, which are not already covered by check or credit card, to Deposit Account No. 502018 referencing this attorney docket. The Commissioner is also authorized to charge any additional fee under 37 CFR §1.16 and 1.17 to this Deposit Account.

Respectfully submitted,

William J. Stoffel 3/28/05

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